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Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Response 2014/014

EASTPORT MARINE PROTECTED AREA (MPA) CASE STUDY IN SUPPORT OF ECOSYSTEMS GOODS AND SERVICES VALUATION

Image: American Lobster

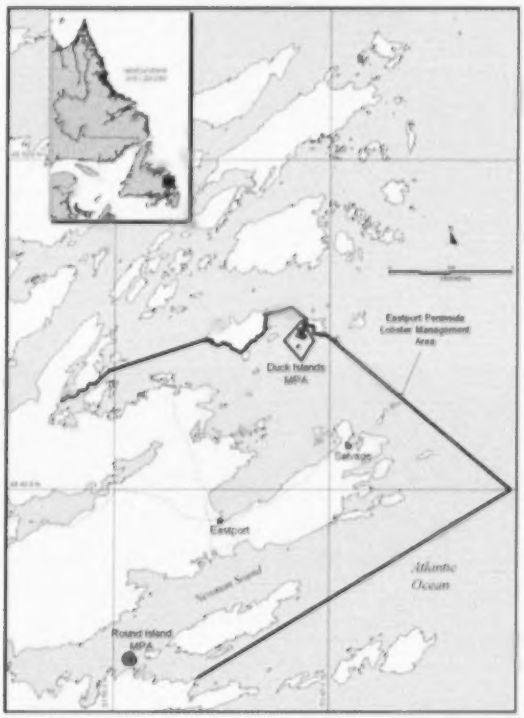

Figure 1. Map of Round Island and Duck Islands Marine Protected Areas and the Eastport Peninsula Lobster Management Area, Newfoundland and Labrador.

Context

In 2012, the Office of the Auditor General concluded a Performance Audit of Biodiversity-Marine Protected Areas (MPAs). One of two key recommendations for Fisheries and Oceans Canada (DFO) was that the Department "*identifies specific ecosystem services provided by existing and planned marine protected areas and assesses their values to better understand their benefits and costs*". In recognition of the complexity of this work and capacity/resource constraints, DFO committed to undertake a benefits valuation case study of an existing MPA by March 2014. The site selected for this study was the Eastport MPA, located off the east coast of Newfoundland, which has the primary conservation objective of maintaining a viable population of lobster through the conservation, protection, and sustainable use of resources and habitats.

Given the data constraints, it was determined that the most feasible approach for DFO Science to contribute to the study of ecosystem services in the Eastport MPA would be to use different geographical areas to compare indicators of population status for a time series between 1997 and 2012. The study involved a review and analysis of the available data for:

a) Estimate of abundance using landings
b) Estimate of abundance using catch per unit effort (CPUE)
c) Estimate of berried females
d) Size structure and distribution

The study analyzed data at two scales where possible: the Lobster Fishing Area (LFA) 5 in which the Eastport MPA is located, in relation to two other LFAs where no MPAs are located (4B and 10: Fig. 2); and the local effects of protected and unprotected areas within the Eastport Peninsula Lobster Management Area (EPLMA).

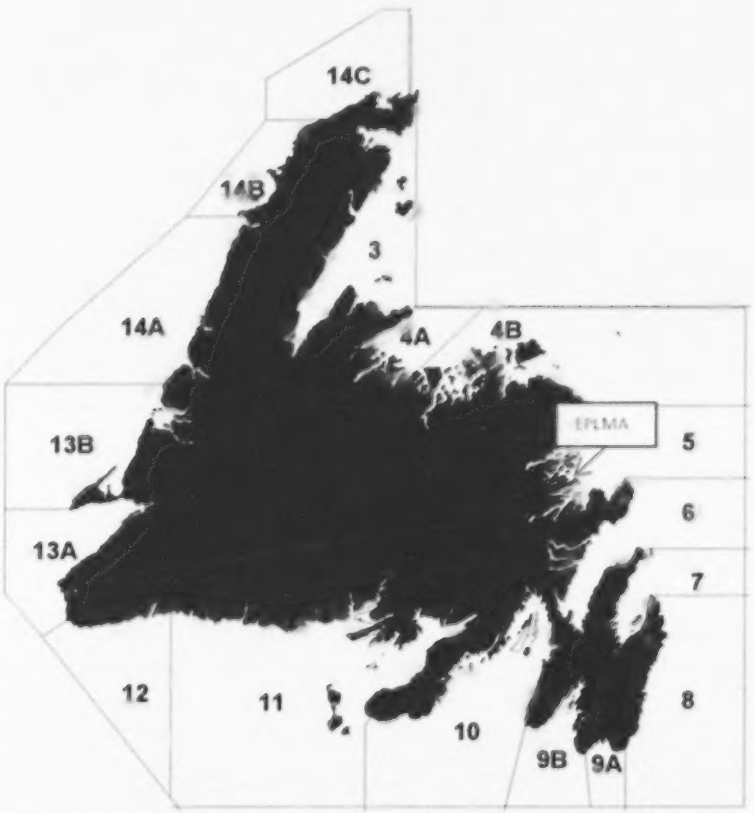

Figure 2. Map of Newfoundland's Lobster Fishing Areas

This Science Response Report results from the Science Response Process of December 10-11, 2013, *Science Advice in Support of the Eastport Marine Protected Area (MPA) Ecosystems Goods and Services Valuation Case Study*. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Background

The lobster fishery in Newfoundland has traditionally been based out of small open boats operating along the shore within close proximity to home port. In response to declining trends in lobster landings along the northeast coast of Newfoundland in the early 1990s, a group of stakeholders in the Eastport, Bonavista Bay area, formed the Eastport Peninsula Lobster Protection Committee in 1995. Their primary goal was to prevent a collapse of the local lobster fishery through the implementation of a lobster conservation strategy for the Eastport Peninsula. In 1997, an agreement between the Eastport Peninsula Lobster Protection Committee and DFO was developed to limit local fisheries and to close two areas known to be productive lobster habitats: Duck Island and Round Island (Fig. 1) which represent a combined total area of 2.1 km^2. Eastport was officially designated as a Marine Protected Area under the *Oceans Act* in October 2005.

The American Lobster (*Homarus americanus*) is a relatively long-lived, cold water shellfish that occurs along the west coast of the Atlantic Ocean, from Newfoundland to Cape Hatteras. Adult lobsters prefer rocky substrates where they can find shelter, but also live on sandy and muddy bottoms. Individuals can have a lifespan of more than 30 years. Commercial activity generally takes place at depths less than 50 m. Lobsters are believed to take approximately 8 to 10 years to reach a carapace length (CL) of 82.5 mm, which is the minimum legal size for Newfoundland. Growth is achieved through molting which in turn is dependent on the age and water temperature. As lobsters age the molting frequency decreases; with large lobsters molting once every few years. Mating occurs after the summer molt in July to September. Female lobsters later extrude eggs to the ventral side of the abdomen where they are fertilized and remain and develop for approximately 9-12 months post–mating. Egg bearing ovigerous females are exempt from landed catch, thus maintaining the reproductive capacity of the population. Fecundity of females increases logarithmically with body size and therefore, the protection of larger females would likely serve to enhance the productivity of the population.

A valuation of the Eastport MPA requires the analysis of data from within the Eastport MPA compared with another area without protection and external to any potential effects of the MPA conservation measures. Various data sources were considered in this case study, including commercial at sea sampling, landings and index logbook data (all available at the management area scale), as well as the fall tagging data (available exclusively for the EPLMA).

Analysis and Response

Indicator #1 - Estimate of abundance using landings

Abundance indicators typically include landings recorded from processing plant purchase slips, catch rates of commercial size lobsters from sampling surveys and logbooks, and densities from trawl surveys. Fishery independent data such as trawl surveys are unavailable for the Newfoundland LFAs; therefore, an alternate method was required to provide a proxy for the abundance values for LFA 4B, 5 and 10.

Presently, there are no working population models for Canadian lobster to provide an estimate of total biomass for any given area or to project future trends in abundance. However, landings are considered the most appropriate proxy for exploitable biomass in each of the three LFAs, given data availability. Therefore, the analysis was conducted on the exploitable biomass as a proxy for abundance-where exploitable biomass, by definition, represents the legal size, non-ovigerous portion of the population.

Management Areas

Estimates of abundance, based on landings, indicated no substantial change in the overall relative abundance of lobster in LFA 5 compared to LFAs 4B or 10. However, the relatively small size of the MPA compared to the size of the LFA could reduce the perceived overall measurable impact on the exploitable biomass in the LFA.

Eastport Peninsula Lobster Management Area

There appears to be a modest increase in the number of lobsters in the population in the Eastport MPAs over time. However, unprotected populations within the adjacent EPLMA have also increased. This increase could have resulted from an overall spillover effect, or it may suggest the adjacent area is too close to separate any spatially distinct effects, or changes operating at a larger scale that may therefore negate the impact of the MPA. The tagging data revealed that only a small proportion of lobsters tend to move between protected and unprotected areas but with no clear directional bias, providing no indication of mass migrations resulting from high density in some areas.

Indicator #2 – Estimate of abundance using catch per unit effort

Catch per unit effort (CPUE) is an index typically used in fisheries as an indicator of abundance of a population. In general, changes in the CPUE are inferred to represent changes to the true abundance based on a non-standardized sampling approach. A decreasing CPUE can indicate overexploitation, whereas a stable CPUE could be indicative of stable population.

The use of CPUE as an indicator has several advantages over other methods of measuring abundance as it does not interfere with routine harvesting operations and can be easily collected from harvesters' records. The ideal practice involves the standardization of the effort employed (e.g. number of traps or duration of searching), therefore accounting for any potential change in catch related to change in effort. The main difficulty using CPUE is defining the unit of effort. In the analysis of the Eastport MPA, available logbook data within LFAs 5, 4B and 10 and within respective statistical sections were combined, and CPUE (number of commercial lobsters per trap haul) averages were calculated and compared based on annual and weekly trends. The mean CPUE was calculated by summing the mean catch (by day, fisher, and area) and dividing by the sum of the mean number of traps for the same period. The calculation of CPUE is not standardized for variation in water temperatures, fishing practices among fishers or for seasonal changes in fishing activity. Inconsistent participation in the logbook program could also influence the utility of the data.

Management Areas

There was no significant difference in estimated CPUE among LFAs. Similarly, analysis of the CPUE data by week of the fishery did not reveal any significant trend although it was noted that the LFA 10 season is slightly longer than that for LFA 5 and even longer than that in LFA 4B, which may be a reflection of fisheries closures.

Eastport Peninsula Lobster Management Area

There were no substantial changes in the CPUE over the course of the entire study at the EPLMA level. However, variability among the years was noted.

Indicator #3 - Estimate of berried females

The estimation of berried females is not typically used for stock assessments in the Newfoundland Region. Berried females and undersized lobsters are not part of the legal catch and cannot be used to calculate the exploitable biomass. Therefore, the estimates provided represent a theoretical value that should be used with caution. It may be more meaningful to

use the proportion of berried females within the population to represent an estimate of productive females over time, compared to data from another area as extracted from the commercial at-sea sampling data.

Using commercial at-sea sampling data and the landings, an estimate of berried females was derived from the exploitable biomass using landings as a proxy as described previously. The numbers were estimated for LFAs 4B, 5 and 10 by using the percentage of legal sized (CL > 82.5 mm) ovigerous females/total number of exploitable lobster measured within each LFA on an annual basis from the commercial at-sea sampling data. This proportion of berried females in the commercial at-sea sampling data served as the basis for comparison of life history differences among areas.

Management Areas

Proportions of berried females were not significantly different between LFAs, and did not change significantly over time. However, an analysis of the reproductive potential for the three LFAs does indicate increasing egg production over time, likely resulting from increased average size (CL) of berried females. This increase in size could be attributable to island-wide conservation measures such as v-notching that would contribute to increased numbers of protected berried females through time, and hence the potential of the population to subsequently produce more eggs.

Eastport Peninsula Lobster Management Area

There were no significant differences in the proportion of berried females in the protected and unprotected areas of the EPLMA. Similar to the analysis presented for the management areas, the reproductive potential per female has increased over time within the EPLMA.

Indicator #4 - Size structure and distribution

An analysis of size distribution can provide a perspective on change in the population's state over time. By studying the change in size distributions of the target species, it is possible to infer the consequences and effectiveness of the management measures. Although they provide an indication of population size structure, careful use of the size-frequency distributions to determine relative abundance of undersize, ovigerous and v-notched animals is essential as these components within the distribution can be overestimated as a result of potential bias in the sampling design. Unlike the commercial component of the catch, which is removed after the first capture, non-commercial animals (undersized lobster, berried and V-notched female lobster) can be captured and recorded multiple times, particularly near the end of the season when the commercial component has been substantially depleted and removed from the fishery (DFO 2009).

Length frequency distributions of all lobsters caught during commercial at-sea sampling were generated and expressed as yearly percentages for both male and female components of the population (males, females, ovigerous females) within LFAs 4B, 5, and 10.

Management Areas

The average size (CL) of female lobsters in LFA 5 has increased since 1997. Although data from the other LFAs are limited to 2005-2012, there is also evidence of a modest increase in average size of females in those areas. The average size of male lobsters has been relatively stable in all three LFAs. The average size of berried female lobsters, like their non-berried counterparts, has remained relatively constant among all LFAs analyzed. Consistent trends among LFAs suggest that processes operating at large spatial scales are affecting lobster populations across eastern Newfoundland. The implementation of v-notching as a management tool is a likely contributing factor in this regard.

Eastport Peninsula Lobster Management Area

A long term trend in the increase in average size of both male and female lobsters has been observed in the EPLMA since 1997. This is largely a result of an increase in the abundance of larger lobsters above the 70th percentile of the annual length frequency distribution. However, the relative abundance of large males from unprotected areas has been declining since 2006.

The evidence of a modest increase in average size of lobsters in other management areas, suggests that processes operating at larger spatial scales are affecting lobster populations across eastern Newfoundland as noted previously – including individuals within the EPLMA. As such, the exhibited size increases cannot be attributed the implementation of the MPA.

Issues in Analysis

Long term projections

The requested projections to 2020 are not possible based on current knowledge. The trends in CPUE indicate a weak increase in the annual mean. Estimates of recruitment trends demonstrated a short term increase in the last two years of the time series but the long term trend was not significant. Carapace length from protected and unprotected lobsters indicates that there have been marginal improvements in the size and relative abundance of the larger lobsters (> 100 mm CL). Therefore, there will likely be limited change from current conditions if environmental conditions and fishing pressure remain relatively constant compared to the current state within the EPLMA.

Data availability

Eastport provides the longest, most continual source of lobster data for the island. These data are rich and can provide insight into the lobster population and fishery in the area. However, in order to compare the state of lobster in the Eastport area with other areas of a similar scale, those areas require similarly complete data. Unfortunately, this is not currently the case; data availability from other areas remains poor. Furthermore, estimates of abundance in the NL Region using approaches such as trawl surveys are not feasible in coastal areas.

Fall research/tagging data

While a lengthy time series of fall research/tagging data exists in the Eastport area, several aspects of the program are actively being improved based on recommendations from the DFO review of Eastport MPA monitoring indictors, protocols and strategies (DFO 2014). As such, a sufficiently longer time series of the newly established monitoring protocols will improve this program, particularly: reference areas located at a greater distance from the MPA; tag returns from spring fishery; and geo-referencing the fall tagging events.

Habitat

Based on a lack of accurate knowledge of the extent of suitable lobster habitats in the area, a comprehensive assessment of the production potential of the lobster fishery, scaled by available habitat, in the EPLMA was not feasible at this time. Although the fishery may provide some indices of where lobsters have traditionally been harvested, the information is largely qualitative and difficult to apply in a predictive evaluation.

Conclusions

Marginal gains in LFA 5 have been shown in comparisons to the two other LFAs. However, there have not been significant improvements in most indicators, making a reliable assessment of any potential fishery enhancement effect of the MPA difficult. This outcome could be attributable to the small size scale of the MPA in relation to the area encompassing the entire LFA.

The assessment at the regional level of the EPLMA found that small improvements in lobster abundance have been made within the MPA area that could eventually result in a spillover effect. A small proportion of lobsters moved between the protected MPA and unprotected areas adjacent to it. The average size (CL) of males in the EPLMA is increasing at a slower rate than that observed in females.

Contributors

Last Name	First Name	Affiliation
Ali	Zeba	DFO Policy and Economics, NHQ
Baker	Jackie	Fish Food and Allied Workers (FFAW)
Beresford	Laura	DFO Oceans, NL Region
Chute	Christie	DFO Ecosystems Management, NHQ
Coughlan	Elizabeth	DFO Science, NL Region
Gregory	Bob	DFO Science, NL Region
Han	Guoqi	DFO Science, NL Region
Howse	Victoria	Centre for Fisheries Ecosystems Research, NL
Janes	Jennifer	DFO Oceans, NL Region
Lewis	Sara	DFO Science, NL Region
Mansour	Atef	DFO Science, NL Region
Meade	James	DFO Science, NL Region
Morris	Corey	DFO Science, NL Region
Mullowney	Darrell	DFO Science, NL Region
Penney	John	Member, Eastport Lobster Protection Committee
Penney	Roger	Co-Chair, Eastport Lobster Protection Committee
Pepin	Pierre	DFO Science, NL Region
Phelan	Fred	DFO Policy and Economics, NL Region
Power	Annette	DFO Oceans, NL Region
Rowe	Sherrylynn	Centre for Fisheries Ecosystems Research, NL
Snelgrove	Paul	Memorial University of Newfoundland
Stanley	Ryan	Memorial University of Newfoundland
Templeman	Nadine	DFO Science, NL Region

Approved by

B. R. McCallum
Regional Director, Science
Newfoundland and Labrador Region
Fisheries and Oceans Canada

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Sources of information

This Science Response Report results from the Science Response Process of December 10-11, 2013, Science Advice in Support of the Eastport Marine Protected Area (MPA) Ecosystems Goods and Services Valuation Case Study.

Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

DFO 2014. Review of the Eastport Marine Protected Area Monitoring Indicators, Protocols and Strategies. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/012.

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Centre for Science Advice (CSA)
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5667
St. John's NL A1C 5X1

Telephone: (709) 772-3332
Fax: (709) 772-6100
E-Mail: DFONLCentreforScienceAdvice@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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